DRAFT FAME CALIBRATION PLAN

A) Purpose:

Identify and specify calibration needs to ensure astrometric and photometric accuracies of observations, and be able to determine systematic errors including monitoring short and long term changes in the entire instrument.

B) Concerns:

a) Photometric:

1) optics throughput and long term changes
2) filters efficiency and long term changes
3) CCD responses, radiation damage, and CTI, pixel changes
4) binning sums vs. psf values
5) FAME photometry vs. standards
6) magnitude dependent differences in measurements
7) Flat Fields, Dark, and bias frames
8) Aperture corrections

b) Astrometry:

1) short & long term rotation changes
2) Point Spread Function (PSF) values across Field of View (FOV)
3) PSF changes with time
4) PSF changes with spectral types
5) optics focus and alignment changes
6) CCD radiation damage, CTI, and cosmetic changes
7) magnitude dependent differences in measurements
8) attitude determination accuracies
9) systematic errors in data
10) Thermal-mechanical stability of FPA, relative movement of CCDs
11) Aperture corrections

C) Measurements required beyond standard observations:

a) Photometric:

1) Postage stamps of stars of 9, 10, 11, 12, 13, 14,and 15 magnitudes on each chip amplifier, weekly for Ba1, Ba2, Ba4, Ba6, Bb3, Bb5, Bb7.

2) Postage stamps of stars of 5, 6, 7, and 8 magnitude on neutral density chips and photometric chips weekly for Ba2, Ba4, Ba6, Bb7.

3) Flat field statistics of each chip amplifier weekly by uniform illumination of internal LEDs when Earth is beginning to enter FOV or somehow without leaving science mode for Ba7.
4) Read out weekly a pattern of blank fields covering each chip amplifier for dark frames for Ba7.
5) Postage stamps of selected calibration stars with different gain settings to determine amplifier linearity monthly for Ba1, Ba3, and Ba6.
6) Take overscan data on a regular bases for all CCD amplifiers and send down during science mode for Ba3, Ba7, and Bb6.

b) Astrometric:

1) Postage stamps around 9th magnitude stars, at least 3 per FOV, continuously for Bb1, Bb2, Bb3, Bb4, Bb5, and Bb8.
2) Postage stamps of stars in sweet spot of distortion at 9, 10, 11, 12, 13, 14, 15 magnitude weekly for Bb4 and Bb5.
3) Big 2D raster of science stars at all magnitudes monthly for Ba8, Bb11, Ba4, and Bb9.
4) Inject a line of charge daily in each chip, compare outcome with a nominal set to detect changes in performance of each column taken in X1 binning of each chip for Ba3 and Bb6.
5) Take big 2D raster of selected science stars when stars are going straight down columns to determine unsmeared PSF and distortion effects for Ba4, Ba8, Bb2, Bb4, Bb5, and Bb11.
6) Focus monitor data sent down during engineering mode somehow for Bb5.

D) Data Reduction Requirements:

a) Photometric:

1) Add 400,000 blank sky "stars" to the input catalog to be read at highest gain setting.
2) Select 5,000 stars near 9th magnitude and 20,000 stars near 12th magnitude in only a few tiles to be read in different gain settings. See Ca5 above.
3) Systematically monitor stars for magnitude changes; separate changes of individual stars from changes per chip amplifier, per magnitude, per long term trend for Ba1, Ba2, Ba3, and Ba6.
4) Compare photometry from Ca1 with binned data for systematic differences.
5) Monitor weekly data from Ca1 and Ca2 for changes.
6) Process zero-level measurements to generate a smooth curve of amp/gain setting corrections.
7) Process blank sky to produce a smooth curve of sky vs. time. Compare to models of zodiacal light vs. ecliptic coordinates. Tune up models from data. Use models for reduction of photometric observations.
8) Generate aperture corrections based on initial adopted PSF. Improve aperture corrections based on improved star colors and image smear.
9) Compare in-flight flat fields with thermal vacuum flat fields, correct as necessary. Monitor flat field changes during mission from 1-D flats. Use 2-D flats to monitor growth of traps and CCD artifacts.

b) Astrometric:

1) Monitor variations in PSF residuals of all observations for systematic variations as a function of chip amplifier, FOV location, and system for Bb2, Bb3, Bb4, Bb5, and Bb6.
2) Monitor attitude determination for accuracy variations for Bb.
3) Monitor weekly data from Ca1 and Ca2 for changes.
4) Monitor 9th magnitude stars of Cb1 for indications of duplicity and replace such stars with others for calibration purposes.
5) Monitor observations from Cb2 for variations in PSF and photon statistics for system variations.
6) Monitor continuously parameter solutions for changes in any parameter.

E) Comparison with ground-based astrometry and photometry:

a) Photometric:

1) Compare ground based photometry to FAME photometry for Ba5.

b) Astrometric:

1) Compare FAME parallaxes to ground based parallaxes for Bb9.
2) Compare FAME data results with known double star cases for Bb9.